AGRICULTURAL Research

MARCH 1956

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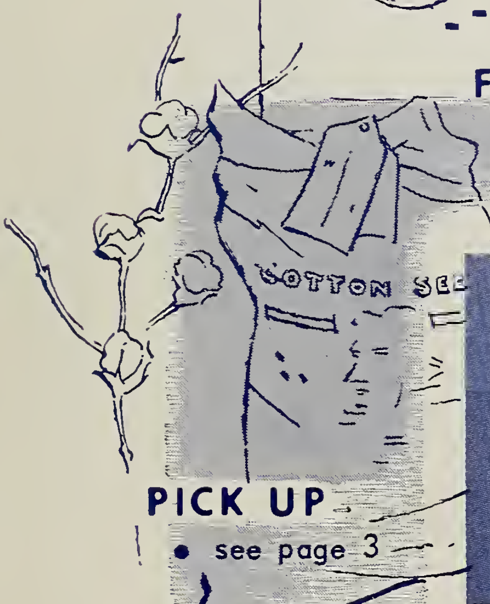

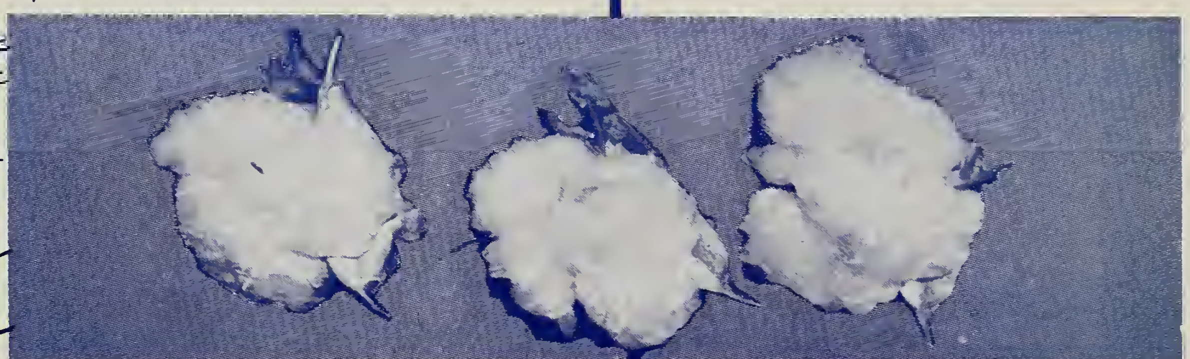

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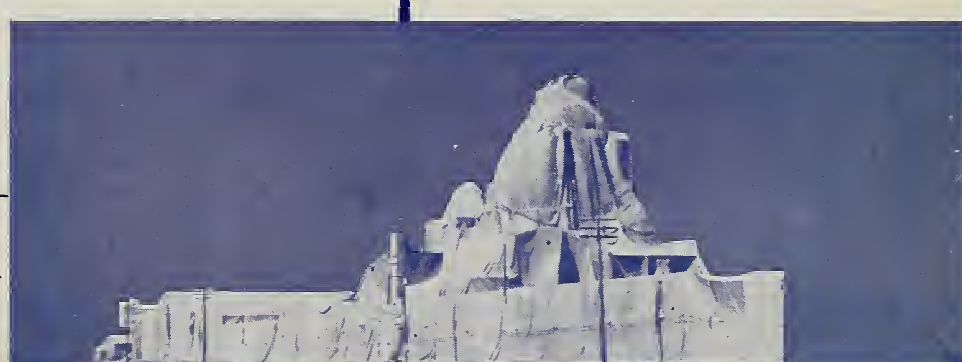

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UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL
Research

Vol. 4—March 1956—No. 9

CONTENTS

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Cost cutting

One of the big agricultural-research opportunities in this country today lies in the reduction of farming costs.

Cost reduction offers a way to help farmers operate with some net income, even when prices are off. And, after all, successful agriculture means something more than producing abundantly—the production must be *profitable to farmers.*

Research can find ways to cut costs in numerous places. Many of them are around our farmsteads, where a lot of time and labor goes into doing things the old-fashioned way. There are similar possibilities in our fields—for example, chemical weed control (see page 5) could reduce cultivation and hand weeding, thus cutting costs without increasing yields.

There's cost-reducing value in improved varieties, too. Pima S–1 cotton (see page 3) not only has better fiber but can also be produced for less than an older variety.

Farmers need more guidelines on costs and returns, and on prospective income under several alternatives often open.

Cost reduction is, in fact, the key to some important developments in agriculture at present. Take the shift to livestock. Since our people want more meat, milk, and eggs, one opportunity for bringing production and demand together seems to lie in greater emphasis on animal agriculture. But that shift will come only as we make it profitable to farmers. This means research must develop more efficient practices, well-adapted grasses and legumes, better control of insect and disease pests, more facts on animal nutrition, surer ways of preventing losses from livestock diseases and parasites.

We know, too, that marketing services make up a big share of the dollar in the price of food at retail stores. Research has made substantial gains in cutting marketing costs, but these gains are only a token of what could be accomplished. Only through research can we get the information needed to make adequate recommendations for stepping up efficiency.

Finding the answers to such questions is vital to our achievement of a balanced, profitable agriculture.

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AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

PIMA S-1 IS PAYING OFF

It's cutting production costs and helping Southwestern growers sell the long-staple market

ORIGINATOR of Pima S–1 cotton, Arizona's W. E. Bryan, examines one of his newer long-staple types. S–1 planting seed is pictured in distinctive bag bearing Pima Indian's face.

PIMA S–1 is big news in the Southwest. Born of research, this is a new long-staple cotton variety that the area's growers and millmen alike believe offers them a sound future.

Pima S–1 has taken hold in an incredibly short time. Created in 1949, it became generally available to growers in 1954. Last year, Pima S–1 was seeded on nearly all the 44,000 acres allotted to long-staple cotton under USDA acreage controls.

Growers like Pima S–1 so well they petitioned the Secretary of Agriculture for a lower support price, and got it. They've thrown energy and cash into a promotion campaign to hasten acceptance of the new variety by the women's-wear trade.

Briefly, here's the story behind this display of confidence:

Southwestern growers who need a good summer crop—and prefer long-staple cotton—found it hard to compete against the imported Egyptian variety, Karnak. Their old standby, Pima 32, compared in quality with Karnak. But the cost of production was too high (except in emergencies when defense needs for this cotton were great) to compete pricewise.

In recent years, therefore, most American-grown long-staple cotton has gone under Government loan—a surplus-building predicament that ended in acreage limitations and an up-and-down existence for growers and processors. In 1954, for example, our mills imported 90,000 bales of Karnak but used only 35,000 bales of domestic long-staple cotton.

Now, with Pima S–1—a high-quality cotton variety that outyields Pima 32 by 20 percent and lowers picking costs by 16 percent—growers believe they can make a good profit by selling at a lower support price.

Their viewpoint is supported by a study in which ARS economists cooperated. It indicates that slow expansion, as markets can be developed,

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is feasible; that the competitive position will continue to improve as research develops ways of cutting production and processing costs.

W. E. Bryan, of the University of Arizona, is the man who made Pima S–1. Head of the Department of Plant Breeding, he carried forward over many years breeding work that finally paid off with a complicated cross involving Pima, Tanguis, Sea Island, and Stoneville Upland varieties.

After preliminary yarn-spinning tests that pointed up the promise of this new variety, ARS entered a cooperative Pima S–1-development program with the University and the Arizona Cotton Planting Seed Distributors, a growers' cooperative. Their efforts quickly brought Pima S–1 to the Southwestern growers.

Seed was purified and increased by growing it over winter on ARS plots in Mexico. More extensive fiber tests were run at the U. S. Cotton Field Station, Sacaton, Ariz. The cooperative aided in the seed increase during the following summer seasons and provided the financing and facilities for seed storage and care.

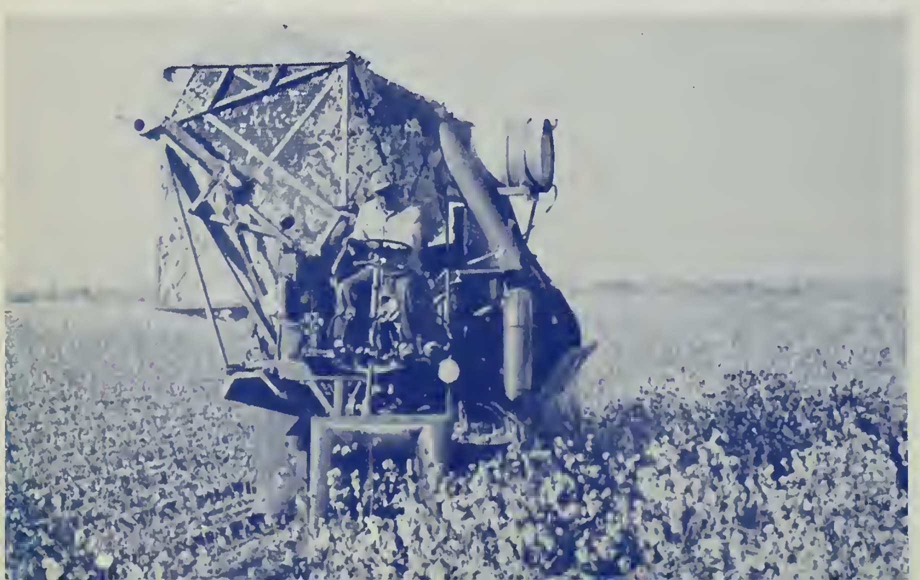
Pima S–1 is good—but not the last word. ARS and Arizona researchers are cooperating to maintain and improve the variety. Last year, 160 strains of Pima S–1 and several crosses involving S–1 and other cotton varieties were being field tested in the search for even better cotton.

Because Pima S–1 came so fast, there are still unanswered questions. But here's how researchers, after 4 years of intensive study, size it up:

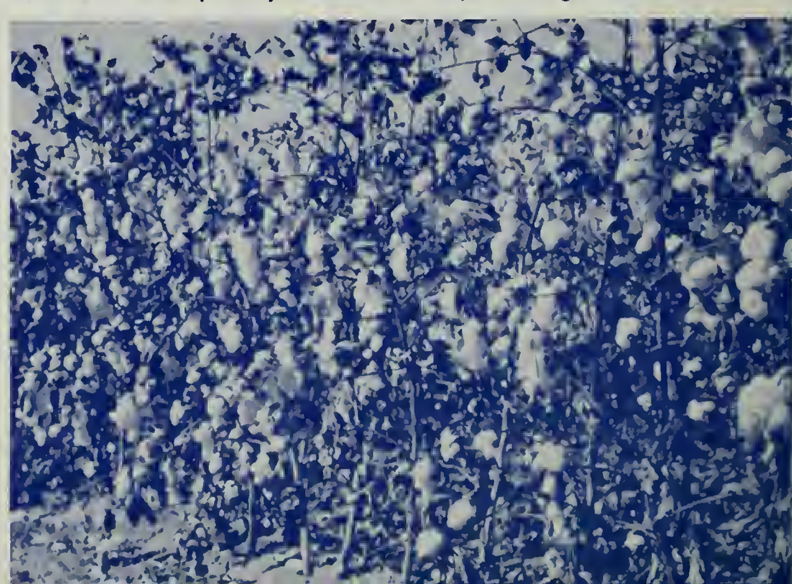
1. Pima S–1 is a good yielder. In field tests at Sacaton and Mesa, Ariz., State College, N. Mex., and Ysleta, Tex., it outyielded Pima 32 by 128 pounds of lint per acre—701 against 573. Pima S–1 is slightly less tolerant to verticillium wilt and is susceptible to bacterial blight (as other American long-staple cottons have been).

2. Pima S–1, being ginned here, also surpasses Pima 32 in spinning tests. Yarn skein strength is about equal, appearance superior. There's less lower-comber waste during spinning—which can cut processing costs. Thread makers who have tested Pima S–1 agree that it can, almost without exception, serve as well as Karnak or Pima 32.

3. Pima S–1's bigger bolls are easier to handpick. Though machine harvesting isn't widely practiced with long-staple cotton, limited experience indicates the short, straight, compact plants of this new variety are of a type most suitable for machine harvesting. Pima S–1 is more generally adaptable than Pima 32 to climatic differences.



4. Pima S–1 is a little later maturing at some higher elevations—a problem if there's early frost. This may be partly due to "hard" seeds; they absorb water slowly, take longer to germinate. At least one seed company believes it can overcome this with a hot-water-bath treatment developed by V. T. Walhood, Los Angeles Cotton Station.



Fertilize crop residues?

MICROBES reduce crop residues with nitrogen usually found in them and in soil.

■ DOES IT PAY to add chemical nitrogen to a crop residue to help it decay into soil organic matter?

USDA soil scientist F. E. Allison says *no;* it pays to fertilize the crop but not the refuse. Why? Under most circumstances nitrogen fertilization won't materially increase the retention of organic matter on a normal soil that's being cropped.

A confusing fact is the generally higher organic content of cropped soils that are heavily fertilized with nitrogen. Allison says it's the larger crop and greater amount of vegetation resulting that makes the difference—not more efficient decomposition salvaging more residue.

When vegetative material breaks down, some of the carbon goes to build microbial cells. Of course, this biological activity also calls for nitrogen and the microbes will get it where they can—from residues and from the soil. But the microbes die and release most of the nitrogen and part of the carbon as humus.

In soil, nitrogen is constantly being released by decomposition of organic matter. This normally makes available 2 or 3 percent of the total nitrogen to plow depth yearly. That may supply in one season about 20 to 50 pounds of nitrogen per acre on poor soil, and 100 pounds or more on fertile soil. This available nitrogen would stay in the soil if the land were uncropped and no residue were applied, except for the fact that rain commonly washes most of it out.

If the land is not cropped but 1 ton of straw is applied, micro-organisms will use 15 to 30 pounds of soil nitrogen; if 2 tons are added, 30 to 40 pounds of the nitrogen will go to the organisms. In either case, nitrogen is likely to be ample. But if a crop is grown at the same time, it must compete with the organisms and will likely get short rations while the decomposition goes on apace.

So adding nitrogen won't affect humus formation much. It will overcome the crop's nitrogen-deficiency systems. That means more crop but no more humus immediately.

Where winters are mild enough, the most readily decomposable portion of the crop residue will be attacked before crop growth starts in spring. Allison says this decomposition may require some of the newly available soil nitrogen that otherwise would be leached by winter rains. This microbial demand on nitrogen will be ended before spring crops come along, although it might cause nitrogen hunger in a winter crop.

The important point is that only so much of the vegetative carbon is going to be retained in the soil, and a large part will escape as carbon dioxide regardless of fertilization. Adding nitrogen will not alter the end result to any great extent.

That's why Allison says: Feed your crop but not the crop residues.☆

HARD ON WEEDS—EASY ON LEGUMES

■ TWO NEW WEED-KILLING compounds, created through research and still in the trial stage, showed good possibilities for wide use in recent cooperative USDA-State tests.

These experimental chemicals proved safer on seedling legumes and certain other easily injured crops than the standard weedkillers now used successfully in other situations. According to ARS agronomist W. C. Shaw, of the Plant Industry Station, Beltsville, Md., the two new chemicals look especially promising and should prove valuable supplements to the materials farmers are now using.

The new weedkillers are 4(2,4-DB), a chemical relative of the familiar 2,4-D, and 4(MCPB), from the same chemical family as the widely used herbicide MCPA. The new ones were found among a group of unusual compounds developed by Government and industrial scientists now working in England and the United States.

According to Shaw, research on these and other new compounds has also given important basic information on how some chemicals are able to kill certain plants without harm-

ing others. Such information is essential for future development of more efficient selective herbicides.

Chemical weed killers such as 2,4-D, MCPA, and 2,4,5-T are already being used on an estimated 30 million acres of cultivated land every year. Thousands of additional acres of range and grassland are sprayed to control weeds and brush. But these herbicides are ineffective in many situations—for example, on seedling stands of legumes, especially those underseeded in small grain.

Farmers in 16 States grow approximately 36 million acres of small grain underseeded with alfalfa, clovers, annual lespedeza, and other legumes. With a safe and effective chemical weed killer to protect seedling legumes, farmers could chemically control weeds on more than twice as much acreage of small grains as they now do. Such a herbicide would also offer a chemical control now lacking in certified legume seed crops (hand weeded at present), in canning peas and flax, in grass-legume pasture seedings, and also in many crops that cannot be sprayed at present because of the proximity of tender crops that would be injured by chemical fumes that drift over from treated fields.

Here are some test results:

In *Montana*, 4(MCPB) gave excellent top kill of Canada thistle and other broad-leaved weeds in canning peas and in established stands of alfalfa and white clover without reducing yields of those legumes.

In *Missouri*, 4(2,4-DB) controlled weeds well in birdsfoot trefoil.

In *Missippi*, both 4(2,4–DB) and 4(MCPB) gave good control of bitterweed and pigweed in a pasture of white clover and dallisgrass without crop injury. Also, 4(MCPB) was much less toxic to cotton than 2,4-D or MCPA—hence, might be safer to use on crops near cotton fields.

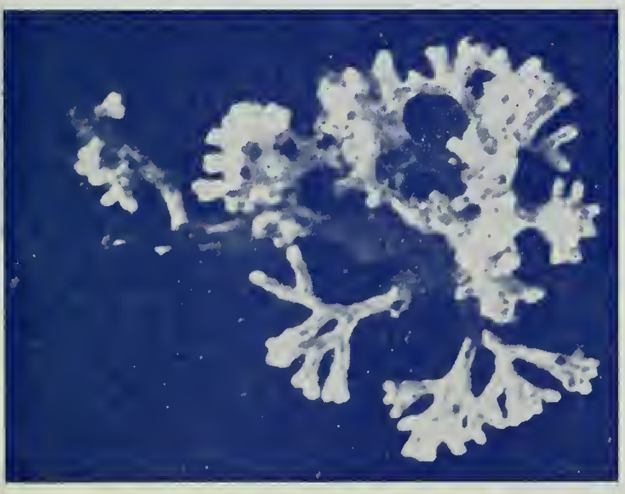
In *Wyoming*, 4(MCPB) killed pigweed and lambsquarter without injury to irrigated alfalfa and snap beans, whereas 4(2,4-DB) controlled the same weeds with no injury to alfalfa but seriously damaged snap beans. The standard herbicides MCPA and 2,4-D injured both crops.

In *Arkansas*, the new chemicals killed weeds in ricefields with less injury to rice than old herbicides.

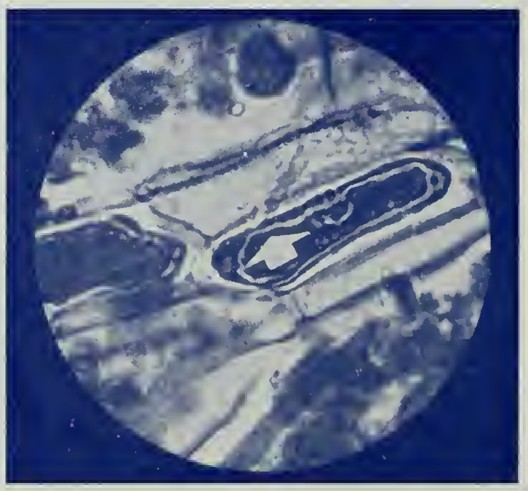
Preemergence sprays with 4(2,4-DB) and 4(MCPB) controlled several annual broad-leaved weeds and grasses with much less injury to corn, cotton, soybeans, peanuts, and sorghum than did preemergence sprays with older 2,4-D and MCPA.

Despite these encouraging preliminary results, USDA won't recommend commercial production or farm use of these new chemicals until further tests have been completed.☆

HELPMATES: SOIL FUNGI AND TREE ROOTS



FUNGI ENCASE pine root like sock, grow between the cells, in ectotrophic mycorrhiza.



MAPLE ROOT section showing endotrophic mycorrhiza has mycelia *inside* the root cells.

■ FUNGI, usually thought of as plant enemies, have come to light as benefactors of the plant kingdom.

Researchers have found that fungi have a mutually beneficial association with the roots of several trees.

Earlier work had already shown that soil fungi and plants aid each other in nutrition. Now plant physiologist E. Hacskaylo, of USDA, and botanist J. G. Palmer, of George Washington University, working at the ARS Plant Industry Station, Beltsville, Md., have learned quite a bit more about this. They found two kinds of mutually helpful (symbiotic) relationships between fungi and two groups of trees and shrubs.

This kind of symbiotic association is called mycorrhiza (pronounced my-cor-RYE-za). Hacskaylo and Palmer describe two types of mycorrhizae that they observed—an ectotrophic type and an endotrophic type.

Under the ectotrophic arrangement threadlike filaments of the fungi form a mantle over ends of a tree's fine rootlets and extend threads into the roots—between the root cells, but not into them. This helps the tree absorb greater amounts of nutrient salts from the soil. Pine, spruce, oak, elm, beech, hickory, chestnut, chinquapin, and birch have this kind of

association with fungi. These species produce an abundance of fine tree rootlets under the influence of growth-regulating substances secreted by the fungi, and the same type of root development when growth-regulating indoleacetic acid is applied to roots.

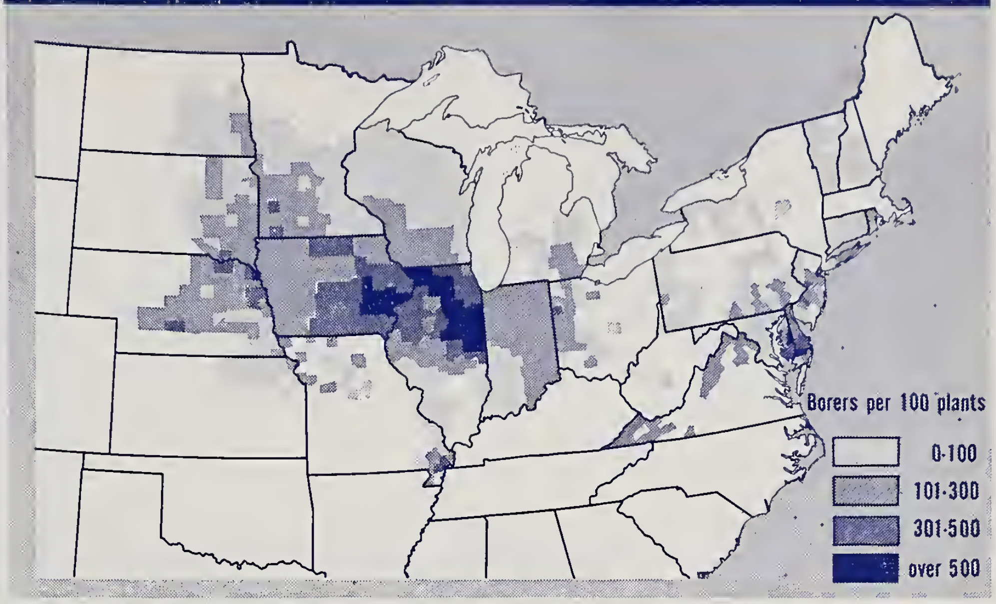
In the case of endotrophic mycorrhiaze, the fungus filaments bore more deeply into the tree rootlets and actually penetrate the root cells. The root tissues digest the fungus and absorb it as additional nutrients. Sweet gum, poplar, maple, laurel, azalea, and rhododendron engage in the endotrophic relationship with fungi. This group of trees and shrubs is not induced to make additional root development either by secretions of the fungus or by treatment with indoleacetic acid growth hormone.

The difference in physiological reaction of these two groups of trees to the fungus secretions seems to indicate that the kind of trees involved, rather than the presence of particular kinds of fungi in the soil, determines which kind of mycorrhiza relationship occurs in a given situation.

Since an interchange of substances takes place between fungus and host, Hacskaylo and Palmer wonder whether the fungi may also secrete antibiotic-type substances—for example, substances that may possibly act against some disease-producing soil organisms or possibly be absorbed into and spread through the host to ward off specific diseases.

In view of these rather significant findings, relationships between tree roots and fungi are likely to receive considerable attention in future plant disease and nutrition research. Better understanding of mycorrhizae might influence our use of soil fumigants, chemical weedkillers, plant-growth regulators and other chemicals—might at least guide us in ways of using chemicals without harm to mycorrhizal relationships.☆

BORERS COULD BE BAD



EUROPEAN CORN BORERS are in 1,644 counties (37 States) from Great Plains eastward. Surveys were made only in these 23 States—area of heaviest infestation.

■ DESPITE A DECREASE in European corn borers since 1954 in several Corn Belt States, a survey by USDA's crops-regulatory staff shows that considerable numbers of these pests are still present over a large part of the area where corn is produced on a substantial scale.

The borer is one of the costliest pests of corn in this country. It is now found in 1,644 counties in 37 States. Although no additional States were reported as harboring the pest in 1955, 8 States, mostly in the South, reported continued spread to 47 new counties.

The study showed that borer populations now are sufficient to cause serious infestations in 1956 corn, if weather favors the insect.

Last fall, agricultural agencies in 23 States checked on the borer's abundance and distribution. Their findings have been consolidated and reported by ARS in the annual Cooperative Economic Insect Report.

If weather favors this insect's survival and development, eastern and northwestern Illinois, southeastern Iowa, and the Eastern Shore of Maryland may expect the largest areas of heavy infestation in 1956, the survey indicates. Many borers were also found in parts of South Dakota, Nebraska, Minnesota, Missouri, Ohio, New Jersey, and Delaware.

Nationwide, the average number of borers decreased from 190 per 100 corn plants in 1954 to 164 per 100 in 1955. But in the East, populations increased from an average of 33 borers per 100 corn plants in 1954 to 90 in 1955. Nine of the 11 Eastern States that were surveyed showed some increases. Most important increases in the borer numbers were reported in Delaware, Maryland, New Jersey, and Rhode Island.

Corn-borer populations in the 12 North Central States last fall averaged 183 borers per 100 plants as compared with 230 per 100 plants found in the fall of 1954. Only 5 of these States—Illinois, Indiana, Minnesota, North Dakota, and Wisconsin—had more borers than in 1954.

Borer numbers have decreased considerably in Iowa, Nebraska, and South Dakota—the 3 North Central States with heaviest infestations in 1954. Kansas, Michigan, Missouri, and Ohio also had decreases. Persistent drought was generally credited with cutting borer populations.☆

a report on the KHAPRA CAMPAIGN

ENTIRE WAREHOUSE is covered with airtight tarpaulin to maintain fumigant concentration strong enough to kill Khapra beetles in walls and on outside. One Arizona plant of 2.6 million cubic feet required 8 acres of tarp, 27,000 clamps, 6½ tons of methyl bromide, 40 pressure gages, 55 vacuum-cleaner motors, 44 1½-inch well points for probes, piping, tubing, and electric wire with control panels and switches. A larger warehouse in California took 9½ acres of tarp and 10.5 tons of fumigant. Rail cars, trucks, ranch buildings, mills, stores are fumigated.

USING tarpaulin by the acre and gas by the ton, entomologists are making good progress in getting rid of Khapra beetles in Southwestern grain storage, milling, and transportation facilities (AGR. RES., July 1955, p. 16). Beetles have been eradicated in more than half the space infested—52 million out of 93 million cubic feet. At the same time, quarantine of premises and treatment of host commodities and grain sacks intended for reuse have kept this dangerous insect pest from spreading.

Inspection is continuing, to make sure that every beetle or larva is found. Quarantine and fumigation will follow as needed. As of January 1, USDA officials had inspected 27,601 properties in 29 States. They found 79 infestations in Arizona, 223 in California, and 4 in New Mexico, according to E. D. Burgess, chief of the ARS Plant Pest Control Branch. In New Mexico, 3 infestations have already been fumigated and cleared; so have 30 in Arizona and 100 in California. USDA, State agencies, property owners, and chemical and pesticide industries are working together on the campaign.

The Khapra beetle thrives on grains and seeds such as barley, wheat, beans, corn, and rice. If it were to reach large warehouses in the Midwest, it could cause incalculable damage to our food, feed, and seed supplies.

Called the world's worst pest of stored grain, the Khapra beetle reproduces at a prodigious rate, is difficult to reach and kill, and thrives or survives in any latitude of the United States. Because it is no larger than a flea—adults measure about one-sixteenth inch—it is often overlooked and carried about on workers' clothing or on grain sacks. Sometimes the beetle is mistaken for other similar storage insects and allowed to go unchecked.

Larvae can survive without food for as much as 3 years—and then vigorously resume eating and growing when the building they are in is refilled with grain. Their flexible life cycle from egg to adult helps them adapt to any condition: in California, for example, the cycle varies from 26 days at 90° to 193 days at 70°.

Many problems have hampered the work of eradication. Conventional spray methods cannot reach Khapra beetles hiding in incredibly tiny cracks in masonry and woodwork. These small insects even work their way through walls to the outside of the building. Researchers found that fumigation with methyl bromide killed all the beetles when it penetrated into and through the walls. But the entire building had to be covered with gas-impervious tarpaulin to hold the fumigant—outside as well as inside—at a lethal concentration.

TINY Khapra beetles and their larvae can penetrate minute crevices, as in cinderblock at top. Below, larvae are eating barley. In heavy infestation, top 2 feet of grain crawls with larvae; sometimes they penetrate as deeply as 9 feet.

The enormous quantity of nylon plastic tarpaulin required—9½ acres in one case—was a problem in itself; it had to be made to order at $2 per square yard. Workers adapted clamps to hold the tarp pieces together with airtight seams. The operation had to be done when little wind was expected because winds normally prevalent in the Southwest can tear or loosen the covering.

Researchers found that gas penetrated more effectively and quickly when air was drawn out and the gas circulated by fans, so forced-air circulation systems were devised. Probes with perforated tips attached to hoses and vacuum cleaner motors were placed about the building and inserted into bulk grain to circulate the gas. Similar probes conveyed methylbromide samples to the gas-analysis station located outside the building for testing. Constant checks on gas concentration were necessary since some seeds or meals absorb the fumigant and reduce the concentration in the building. When this happened, additional fumigant was pumped in. Highly sorptive material had to be covered and given more gas.

Although the eradication measures have been costly and difficult, they are well worth while. In California, fumigating operations to date have cost only one-half of 1 percent of the value of the crops they protect. ☆

PIECE of nylon plastic tarp for covering warehouse is attached by man hanging from derrick. Clips placed on airtight seams hold pieces together. Job is done quickly to prevent change of wind from tearing tarp. Cover is anchored under 1 foot of earth around base.

PROBES attached to hoses and circulation apparatus are placed about building and inserted in grain before fumigation. Some draw off air to hasten penetration of gas; others carry gas samples to analysis station for test of fumigant strength in building, contents.

CHECK on concentration of gas taken through probes is made every few hours with electric gas analyzers. Dosage is 5 pounds methyl bromide per 1,000 cubic feet of space, held 48 hours. When commodities absorb fumigant, more must be added to maintain level.

Now two fungus diseases of vegetables give in to an antibiotic

STREPTOMYCIN saved limas (left); downy mildew killed others.

■ TWO MORE IMPORTANT vegetable diseases—downy mildew of lima beans and late blight of tomatoes—have been controlled experimentally with streptomycin in USDA research.

ARS scientists W. J. Zaumeyer, R. E. Wester, and S. P. Doolittle reported these successes from greenhouse experiments at the Plant Industry Station, Beltsville, Md. These and similar findings from earlier research are an advance toward more extensive use of antibiotics in the campaign to control troublesome plant diseases.

Not only is it important that a control has been found for these two diseases that are difficult to control—it's equally significant that commercial formulations of streptomycin proved more effective than the pure forms against both diseases. Moreover, very low dosages were effective when they also contained a much cheaper material, copper. Our scientists will follow both leads in their continuing search for antibiotic controls that can be used at a practical cost.

Antibiotics have already proved successful against several *bacterial* diseases of vegetables, including halo blight of beans, bacterial spot of tomatoes and peppers, potato seed-piece decay, black rot of rutabagas, and bacterial blight of celery. Now the two *fungus* diseases of vegetables have been added to this list.

In some of the tests, 3 different commercial antibiotic preparations (Agrimycin, Phytomycin, and Agristrep) were applied to foliage at the rate of 100 parts of the drug to 1 million parts of water. Twenty-four hours later, the lima-bean plants were heavily inoculated with the downy mildew organism and the tomato plants with the late-blight fungus. The treated plants were almost totally free of disease, in contrast to severe infection on control plants inoculated with the organisms but not treated.

A mixture—50 parts per million each of the streptomycin and copper—was slightly more effective against downy mildew than sprays containing 50 p. p. m. of streptomycin alone, and much better than sprays containing 50 p. p. m. of copper alone. Sprays having just 25 p. p. m. of streptomycin alone were ineffective.

The fact that better disease control was achieved with commercially formulated streptomycin than with pure forms may be due, the scientists think, to some unidentified ingredient in the commercial formulations that's absent from the pure form of the chemical.☆

Chemical may be what it takes to get good Anjou pears to set a full crop of fruit

■ A FRUIT-SET SPRAY may bring us greater yields of the high-quality but often low-yielding Anjou pear, if preliminary research findings are supported by further studies.

The Anjou often fails to set a capacity crop of fruit, even after blooming profusely. An orchardist's only remedy—severe pruning of the tree—stimulates fruit set but at the same time reduces the amount of fruiting wood. Any plan to get as many fruits on a tree as its leaf area can support will naturally be welcomed.

The chemical 2,4,5-TP, best known as a herbicide and quite injurious to plants when used excessively, increased yield of Anjou pears as much as 60 percent in some instances in Oregon and Washington experiments. Horticulturists E. S. Degman and L. P. Batjer, working cooperatively for USDA and the Washington experiment station, found that the increase was due almost entirely to the greater number of fruits. The best fruit set followed spraying of the trees in late August and early September. Although far more fruits were formed in the summer following the treatment, there weren't too many of them to be supplied nutritionally by the available leaf area of the tree.

Degman and Batjer tried the chemical in various concentrations and applied at various times. Some results were inconsistent. With Bartlett pear, 2,4,5-TP causes fruit breakdown, and cannot be used. These results emphasize the need for further tests under varied conditions before commercial use can be advised.☆

No answer yet for East's unexpected mildew in apples

■ WITH THE ADVENT of organic fungicides for apple-scab control, powdery mildew—the disease eastern orchardists largely forgot—has unexpectedly become the number 1 disease problem to contend with in the eastern apple orchards.

For many years this disease was held in check along with apple scab by the lime-sulfur sprays. Although lime-sulfur controls these diseases effectively, it burns the foliage and fruit, which lowers both yield and quality. So orchardists switched to the less-injurious organics. These work just as well against scab—but are ineffective against the mildew. That brought on our mildew problem.

Powdery mildew works fast when leaf buds—winter shelter of the fungus—open in the spring. If the foliage isn't coated with lime-sulfur or some other effective fungicide, the fungus spreads its long threads over the young leaves. producing a new crop of spores and killing the leaves. This destroys part of the tree's nutrient-making facilities.

Later in summer or early fall, more spores alight on tender new buds and penetrate into the tiny leaves, where the fungus spends the winter.

Powdery mildew is particularly injurious to the important Baldwin, Cortland, Gravenstein, Jonathan, Monroe, Rome Beauty, Stayman, and Yellow Transparent varieties. It hasn't been observed on McIntosh, Red Delicious, and Golden Delicious.

Many chemicals, including antibiotics, are being tested. At the present, sulfur and one organic chemical—known as Karathane or Mildex and chemically identified as 2-capryl-4,6 dinitrophylcrotonate—are the only preparations that give evidence of control. The fact that the organic chemical is effective and noninjurious, though expensive, encourages investigators to hope for success in their search for antimildew chemicals.

Both Federal and State researchers are trying to learn more about this disease problem—precisely when the fungus invades the leaf buds, how to reach the encased leaflets with a fungicide, and how to keep down the disease during the growing season.

Meanwhile, USDA specialists urge orchardists to follow recommendations of their State experiment station on ways to meet the problem.☆

Mushrooms look better and yield better when they're sprayed with chlorinated water

■ ADDING CHLORINE to water for spraying mushrooms effectively controls four common diseases and improves yield and appearance of mushrooms at little extra cost or labor.

USDA mycologists T. T. Ayers and E. B. Lambert made this discovery at the Plant Industry Station, Beltsville, Md. They suggest trying chlorinated water extensively in commercial mushroom houses—100 parts of chlorine per million parts of water.

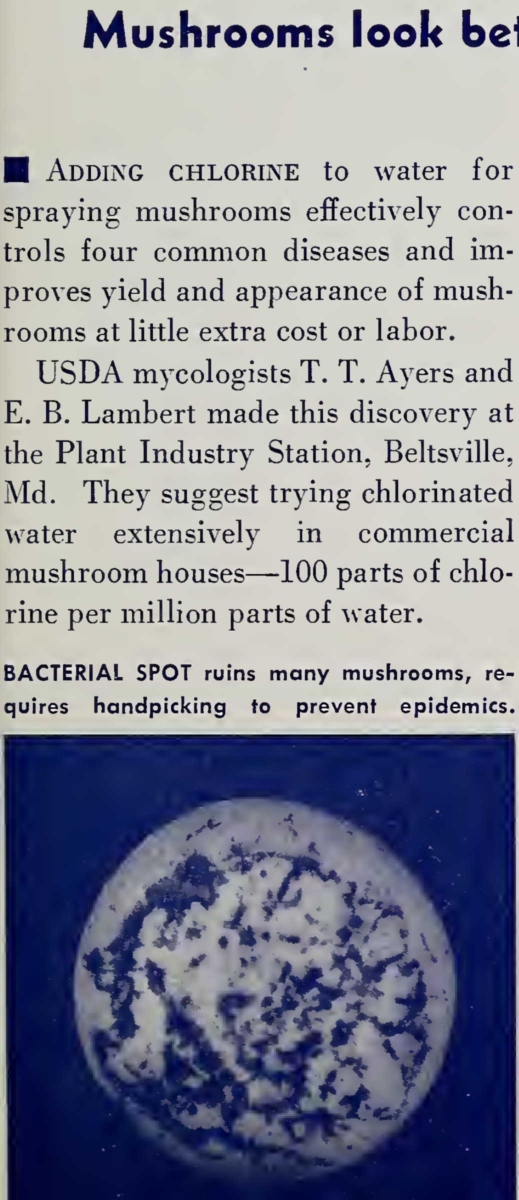
An interesting thing about chlorine is its selectivity between fungi. It is effective against some disease-producing fungi, yet nontoxic to the mushroom, which also is a fungus.

Chlorinated water is no cure-all, the ARS scientists say, but by delaying emergence of diseased mushrooms, such sprays increase yield and appearance of top-grade specimens.

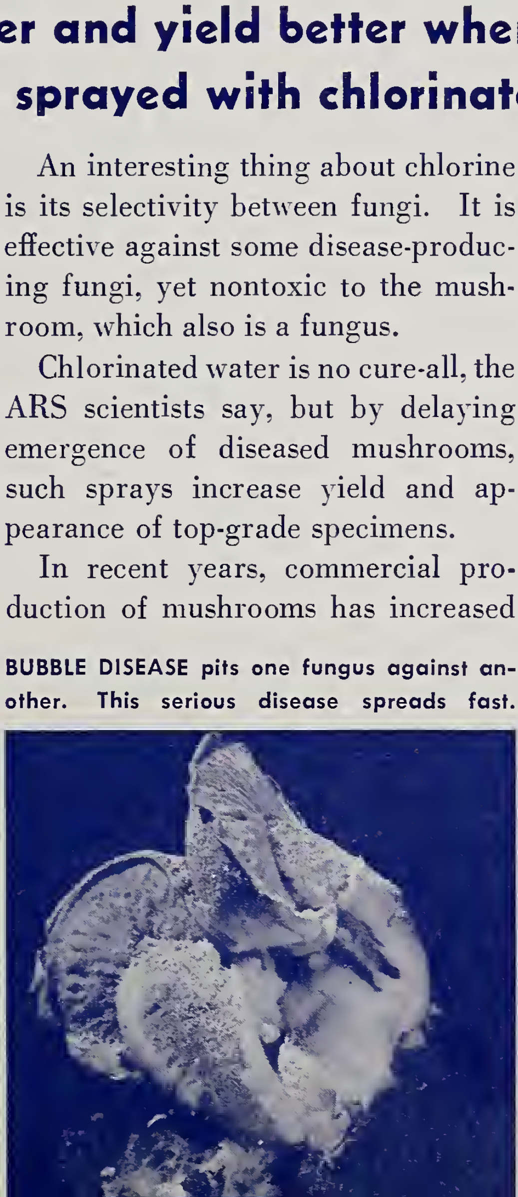
In recent years, commercial production of mushrooms has increased from 1 pound on the average to 2 pounds per square foot of bed space. In some cases, considerably higher yields are obtained. This increase is largely the result of research by the mushroom industry, several State experiment stations (particularly the Pennsylvania station), and USDA.

Ayers and Lambert say there is reason to expect still better yields, as well as a more attractive product, through the use of chlorinated water.☆

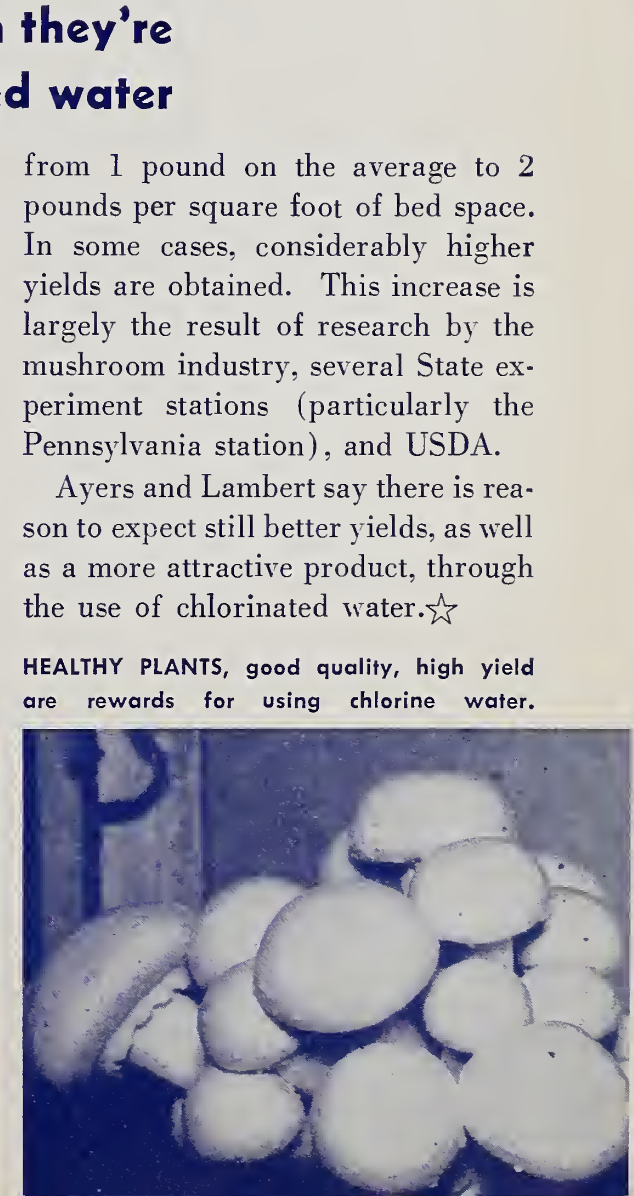
BACTERIAL SPOT ruins many mushrooms, requires handpicking to prevent epidemics.



BUBBLE DISEASE pits one fungus against another. This serious disease spreads fast.



HEALTHY PLANTS, good quality, high yield are rewards for using chlorine water.



livestock

NEW LOOK-MORE PROFIT

Researchers find smooth, open-faced sheep do best on the western range

GREATER profits and production efficiency from open-faced and non-wrinkled sheep are promised western-range meat and wool growers.

Attesting to these prospects are open-faced and nonwrinkled types that are now being developed cooperatively by USDA's Sheep Experiment Station, Dubois, Idaho, and the Idaho experiment station.

Open-faced sheep, in several years of trial and comparison, have shown superiority in meat production over wool-blind sheep in the same flocks.

Development of smooth sheep at the station is also helping. They are easier to shear and produce longer staple, higher value wool than wrinkled sheep. And feeders and packers prefer smooth lambs. Packers frequently offer less for wrinkled lambs because of their heavy pelts.

Wool-covered faces and wrinkled shoulders and sides were once as closely associated with sheep production as a sheepherder and his dog. For centuries, breeders reasoned that because wool production is a function of sheep, the face areas provide added space on which wool should be grown. This theory is not borne out by the work of Dubois researchers in their attempts, over many years, to develop sheep suited for wool and meat production under range conditions in the United States.

Wrinkled sheep, having a greater skin area, are valued in Australia, where wool production is of prime importance to the growers. But such animals are less desirable to range growers in this country, where meat production is the major objective.

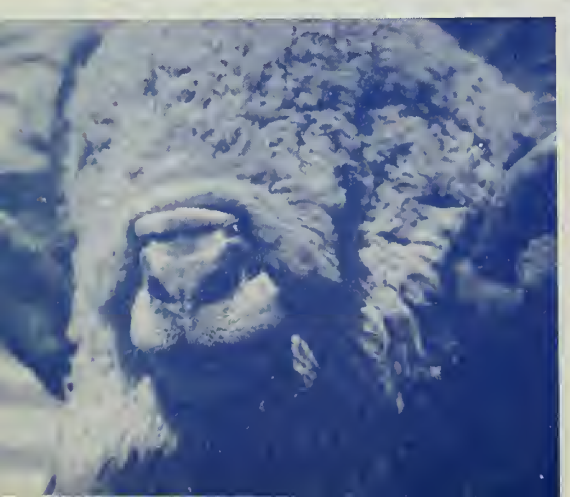
A wool-blind sheep may produce slightly more wool (usually about 0.2 pound) than an open-faced sheep. But this adds only about 10 cents to the value of the whole fleece.

Any advantage gained through the present slightly higher wool output in wool-blind sheep is offset many times by their lower output of lambs. Because they can't see well, such ewes probably don't graze as efficiently on the range as open-faced ewes. The wool-blind ewes probably eat less, which may account for their lower production of lambs as compared with the number that open-faced ewes produce. On an average, open-faced ewes at Dubois have produced about 11 pounds more lamb, liveweight, per ewe per year than wool-blind ewes. A wool-blind ewe would have to yield at least 4 pounds more grease wool than her usual production to make up for this difference in lamb output.

Producers who raise open-faced sheep derive most of their advantage from the greater number of lambs born per ewe and their higher weaning weights. Also, a higher proportion of open-faced ewes become pregnant and the viability of their lambs is substantially greater than that of lambs produced by wool-blind ewes.

Sheepmen in a large part of the western range area have long accepted the axiom that it takes the first 50 pounds of lamb a ewe produces to pay the cost of production. Wool-blind ewes, on the average, wean only about 64 pounds of lamb per ewe, leaving a net of 14 pounds for the

WOOL-BLIND sheep have difficulty finding all the feed they need on western ranges, where grass sometimes grows sparsely and sheep must rustle for a living. So they usually produce fewer lambs, with lower viability. Open-faced sheep, researchers find, are better adapted.



WRINKLED sheep are difficult to shear. The lambs they produce, because of having heavier pelts, frequently bring less than smooth lambs.

grower's return. Open-faced ewes, however, wean an average of 11 additional pounds of lamb. That's a net return of 25 pounds for the grower, or fully 78 percent more net gain.

There are further disadvantages in producing wrinkled sheep. Because they're more difficult to shear, considerable damage may be done to the skin with shearing knives. In southern areas, shearing cuts and abrasions may mean infestation by screwworms. In any area, deep side and neck folds provide ideal incubators for mites, ticks, and other insects.

C. E. Terrell, recently brought to the Agricultural Research Center, Beltsville, Md., to direct all ARS sheep research, has supervised the breeding of smooth and open-faced sheep for meat and wool production on western ranges. Now continuing at Dubois under J. E. Nordby, this is part of the overall improvement effort being made for growers in the 11 Far Western States and Texas.

This phase of the work has been conducted largely with the Rambouillet breed because of its ability to produce fine-quality wool. Rams and ewes were selected originally for partial smoothness and open faces. Through breeding and selection, stability in these characteristics has been built up encouragingly. So far as Dubois Rambouillets are concerned, researchers feel they have gone about 90 percent of the way in removing skin folds and wrinkles, about 50 percent in removing wool-blindness.☆

he smooth sheep produce wool of high quality nd long staple. They are easy to shear and heir lambs are in demand by feeders, packers.

Big thyroid glands— linked to high production?

■ Development of large thyroid glands may become a new and highly important phase of breeding and selection of poultry and livestock for greater output of eggs and meat. The means to determine that possibility—favorably or unfavorably—are two distinct lines of New Hampshire Red chickens that scientists have developed at the Agricultural Research Center, Beltsville, Md., for this purpose.

Birds making up one experimental line have large thyroid glands—birds in the other line have small glands. Both groups of chickens will be placed on similar feeds. Their records as individuals and groups will be kept and compared at the end of a specific feeding period to determine differences in rate of gain and egg production.

Making this experiment possible are investigations that were begun in 1953 by ARS poultry geneticists C. W. Knox, and W. E. Shaklee, formerly of the poultry husbandry research staff. The scientists began by making random selections of New Hampshire Reds to be used eventually in the feeding and egg-laying trials. Test birds among the original selections were killed at 4 weeks of age and their thyroids weighed.

On the assumption that their genetic constitution would be similar, brothers and sisters of test chickens having large or small thyroids were placed in two groups as breeders and for egg-production trials.

Breeding and selection, along with the killing of test birds and the weighing of their thyroids, followed in successive generations. Now in the fourth generation, the two separate lines of chickens show wide disparity in thyroid weight. The average runs 32.8 milligrams in the "high" line, compared with 18.2 milligrams in the "low" line.

With this big difference, Knox and others who will aid him feel that the feeding trials should show whether the assumption that large thyroids are linked with high hatchability, rapid growth, and egg production is true or false. Both groups of chickens will receive identical rations used ordinarily for broiler production, and both will be housed and kept under the same environmental conditions. So far as is known, the experiment will be the first that poultry scientists have made with chickens of known and distinctly different thyroid weights.

High heritability of thyroid weight was indicated by statistical analyses as well as progress obtained through breeding and selection. This finding—should the feeding trials show correlation between large thyroids and hatchability, rapid growth, or egg production—offers encouragement to the possibilities of future breeding and selection work. ☆

dairy

Enough Fertilizer to PAY

THE EXTRA PASTURE FROM A SMALL APPLICATION WON'T COVER ITS COST

RESEARCH has often shown that successful dairy farming is linked with the availability of adequate, high-quality pasture. It's also evident that cost of production of such pasture is just as inseparably combined with a dairyman's profit.

Studies begun at USDA's Dairy Field Station at Huntley, Mont., 4 years ago, point up the fact that pasture costs vary widely. The work indicates a definite profit advantage in fertilized permanent pastures compared with unfertilized pastures, despite the lower paper cost of the latter. Unless fertilizer is applied in adequate quantities, however, the increased pasture output will not pay for the cost of the fertilizer.

A dairyman's success is measured first in terms of milk and butterfat production for profit. In addition, body weight must be maintained.

ARS dairy husbandmen and State cooperators at the Huntley station have applied these rules to determine the relative production and cost efficiency of various experimental pasture treatments. Another measure used is comparison of pasture value with the value of alfalfa hay.

Pasture plots averaging 0.84 acre were seeded to the "Huntley mixture," containing about 4 parts each of smooth brome seed, Kentucky bluegrass, and Alta fescue, 6 parts of orchardgrass, 2 parts of Ladino clover, 1 part of Kenland red clover.

Treatments, following seeding and growth the first year, included: (1) fertilization, and renovation by disking; (2) fertilization alone; (3) renovation alone; (4) neither fertilization nor renovation, as a check.

Each treatment was applied to six separate plots to provide sufficient feed for the cows used in each experiment. The cows were weighed as they were turned into the plots and again after each plot was completely grazed, usually in about a week. Individual milk and butterfat production records were kept for all animals. The figures thus obtained were used to compute the total digestible nutrients (TDN) obtained by each cow from each pasture plot each day.

Ability of the various plots to produce feed was judged on the basis of the daily requirements of individual cows. Feeding standards show, for example, that a 1,500-pound cow requires 11.8 pounds of TDN for body-weight maintenance and 2.8 pounds to produce 10 pounds of 3 percent milk, or 32 pounds to produce 10 pounds of 4 percent milk.

Renovation, a part of the study, was first applied as a practice in 1954—4 years after the work was begun. The results will be checked and repeated at 4-year intervals.

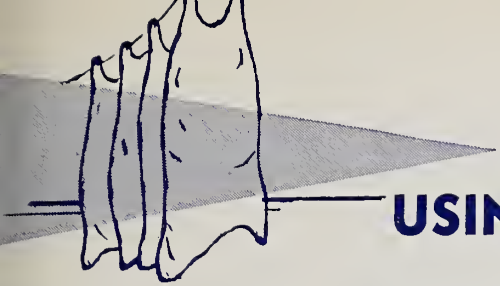
Heavy applications of superphosphate (500 pounds per acre) were used when the experiment began. Nitrogen was also applied at the start and thereafter twice a year (spring and summer) in the form of ammonium nitrate. This was put on at 350 to 400 pounds per acre, and in heavier applications of up to 550.

Fertilized pastures—compared with unfertilized—produced 400 pounds more TDN in 1951, 656 more in 1952, 1,158 more in 1953, and 1,707 more in 1954. The latter represented a 44-percent increase over the output of the unfertilized pasture.

Only heavily fertilized pastures outproduced the unfertilized from the viewpoint of profit over fertilizer outlay. On pasture treated the first year with 350 pounds of nitrogen per acre, the fertilizer cost \$7.50 more per acre than the pasture was worth (in terms of value equivalent to alfalfa hay). Second-year pasture production was worth \$2.50 less than the cost of 400 pounds of fertilizer per acre. The third year, with 550 pounds per acre, pasture value exceeded fertilizer cost by \$5.03. And in the fourth year, fertilized at the same rate, the pasture was worth \$19.73 above fertilizer.

Aside from fertilization results, these studies have also shown the advantage of various practices designed to reduce damage to pasture and extend its usefulness. Huntley researchers subdivide experimental plots by movable electric fences. These confine the cattle to small areas and prevent trampling and contamination of unused portions. The fences are moved each day or two to keep fresh grass always available.

After cattle graze 6 to 8 days, each plot is clipped so that the pasture growth is uniform. This is followed by a light harrowing to break up and distribute droppings. Such practices, following grazing, are important to good pasture management.☆



USING BEEF MOST EFFICIENTLY

■ USDA NUTRITION RESEARCHERS have been investigating Army beefs—edible beefs, that is—at the request of our country's Armed Forces.

And these ARS scientists have come up with some information that can serve as a guide to making sure that servicemen get enough protein and food energy from their daily meals. At the same time, the researchers have found a way to reduce plate waste, conserve freezer storage space, and simplify the handling of meat by having it trimmed of excess fat.

Much of the information can also be applied to other organizations that are engaged in feeding large numbers of people. And those families who own home freezers or rent lockers will be interested in the storage-space implications of the research.

Feeding programs of our Armed Forces furnish a large part of the protein and food energy (calories) in servicemen's diets through meat servings. For this reason, knowing nutrient losses during cooking or by plate waste is vitally important.

For economy in storage and shipping, "4-way boneless beef" is used more and more by the Armed Forces. So the study is based on "4-way beef," which provides: (1 and 2) roasts or steaks to be cooked by dry or moist heat; (3) diced meat for stews; and (4) ground meat for such dishes as meat loaves and hamburgers.

The chemists studied beef servings in Army messes on five different posts to get most of the research information. Beef and plate waste from messes on a sixth post were analyzed in a fat-trimming study.

In terms of the original beef, it was calculated that the servicemen got 67 percent of the food energy of the beef, 84 percent of the protein, and 51 percent of the fat.

When surface fat was trimmed from roasts before cooking, the chemists found that the fat in plate waste decreased without decreasing the amount of fat actually eaten.

The research points up the fact that large amounts of fat on beef are lost in plate waste and in cooking. So fat trimming might as well be done earlier to reduce the amount of valuable freezer storage space needed for meat and to cut down the weight to make handling more efficient.

More basic still, from the standpoint of economy for all—producers, packers, and consumers—findings indicate possible benefits that could develop if feeders sent animals to market bearing less carcass fat.

A technical bulletin on this work has been published by USDA. The title is "Boneless Beef: Raw, Cooked, and Served . . . Results of Analyses for Moisture, Protein, Fat, and Ash," No. 1137. Authors of the bulletin are researchers E. W. Toepfer, C. S. Pritchett, and E. M. Hewston.☆

THAT PINK COLOR IN POULTRY

■ PINK COLOR in well-done roasted poultry has caused many homemakers some concern. What's the significance of this pink color that may appear just under the skin?

Scientists at USDA's Western Utilization Research Laboratory found that pink color in thoroughly cooked poultry results from the same chemical reaction that causes redness in ham, and other smoked or otherwise cured meats. Quality is not affected.

The explanation is that any flame—of a gas oven burner, wood in a barbecue pit, or even the hot surface of some electric heating elements—produces minute quantities of gaseous carbon monoxide or nitric oxide, or both. These compounds, in normal and very small amounts, react with the small amount of hemoglobin that remains in the flesh of slaughtered, well-bled birds. The result is the familiar bright pink or red color.

Smoke used in preparation of cured meats will also give these effects, as will curing solutions that contain nitrate or nitrite salts—forms of the nitric oxide previously mentioned.

Extent and intensity of the color are influenced by the temperature of the flame or heater, the manner of roasting (that is, in covered roaster, wrapped in foil, or in an open pan for various periods), and the age and amounts of fat in the skin.☆

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agrisearch notes

A. S. HOYT retired December 31 from his position as Director of Crops Regulatory Programs for ARS and was succeeded by W. L. Popham.

Dr. Hoyt has held important posts in USDA for 25 years, including 3 years as chief of the former Bureau of Entomology and Plant Quarantine. Before that, he worked in California's pest-control program for 20 years.

Dr. Popham was born and educated in Montana and has been in USDA plant pest control work for 33 years—in charge of it for the past 15 years.

E. D. Burgess, former assistant chief of the Plant Pest Control Branch, succeeded Dr. Popham as branch chief. Mr. Burgess has been associated with USDA intermittently in entomological work for more than 30 years.

MORE AND BIGGER ROSES will reward you for fighting blackspot year in and year out without fail, USDA research shows.

Growers generally dust their roses only when blackspot appears, and just for the current infection. Now, ARS plant pathologists W. D. McClellan, E. A. Taylor, and F. F. Smith have found that this is not enough. In studies at the Plant Industry Station, Beltsville, Md., the researchers demonstrated that continuous treatment—regardless of the immediate need—gave fuller control than dusting merely when the need shows up. This treatment curbs disease that's overlooked.

Good control was obtained in these experiments with a 6-percent formulation of zineb, also with mixtures containing 3.4 percent copper and 24 percent sulfur, or 7.6 percent ferbam and 25 percent sulfur.

As an example, the blackspot-susceptible Golden Masterpiece variety had 83 percent infection in September 1954 and 55 percent infection in June 1955 in untreated plots. But other plots dusted regularly throughout 1954 with the fungicide zineb had just 42 percent infection in September of that year, only 25 percent infection the following June.

Twice-weekly cuttings of Golden Masterpiece early in the season (May and June) further proved the carryover value of blackspot control, the scientists found. Bushes dusted with the copper-sulfur mixture yielded 1,479 blooms that averaged 11.7 grams per bloom in May and 11.3 grams in June. Comparable but untreated rose plots yielded only 492 blooms averaging 11.3 grams in May and 9.8 grams in June.

Dusts were applied once a week during the growing season in these tests. Other frequencies will be studied in future experiments.

STILBESTROL FEEDING may be responsible for heavier weights of some of the steers marketed last fall—up to 75 pounds more per steer than a year earlier.

Results of stilbestrol feeding at USDA's Agricultural Research Center, Beltsville, Md., were reported recently by T. C. Byerly, assistant director of livestock research for ARS. He said cattle receiving stilbestrol in the fattening ration must be fed just as long to attain desirable finish as cattle not given stilbestrol.

Since it has been established that cattle gain faster and more per pound of feed when fed stilbestrol (AGR. RES., November 1955, p. 16), it's only logical that widespread use of the chemical would lead to marketing heavier cattle.

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